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Mental barbel variation in *Pogonophryne scotti* Regan (Pisces: Perciformes: Artedidraconidae)

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Abstract: The mental barbel, an important diagnostic character among notothenioid fishes of the family Artedidraconidae, is highly variable in *Pogonophryne scotti*. A collection of 92 specimens of this species from the South Orkney Islands, comprising both sexes and a wide range of sizes, was studied to determine intraspecific variation in barbel size, shape and ornamentation (development of papillae and folds, especially on the tip). Four distinct barbel types, based on external morphology, are represented in this material: *scotti* (4.3%), *phyllopogon* (28.3%), *dolichobranchiata* (4.3%) and brainlike (38.1%). Indeterminate barbels (25.0%), observed in specimens of both sexes and all sizes, exhibit varying degrees of ornamentation and suggest that all barbel types represent the range of variability in *P. scotti*. There is no correlation between sex and barbel type. Barbels exhibit negative allometric growth relative to body size. Specimens of at least 119 mm SL generally exhibit greater development of the terminal expansion, resulting in a convoluted brainlike appearance previously unrecorded for *P. scotti*. Indeterminate and *phyllopogon* barbels are most common among specimens of 119–210 mm SL. All barbel types are similar histologically. A core of pseudocartilage is surrounded by connective tissue, and the entire barbel is well supplied with blood vessels and nerves. Papillae and folds are dermal projections covered by epidermis. The variation exhibited by the barbel of *P. scotti* formerly served as the basis for distinguishing this species from the invalid species *P. phyllopogon* and *P. dolichobranchiata*. Such intraspecific variation is atypical for *Pogonophryne* but underscores the need to fully validate any taxonomic character.

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Introduction

The mental barbel is a synapomorphy for the 25 species of Antarctic notothenioid fishes of the family Artedidraconidae. It is an essential diagnostic character that is highlighted in systematic works, summaries and keys to the fish fauna of the Southern Ocean (Andriashev 1967, 1986, Eakin 1990, Miller 1993). With 17 species, the genus *Pogonophryne* is the most speciose in both the family and the suborder (Eastman & Eakin 2000) and presents a considerable taxonomic challenge. The species of *Pogonophryne* possess only lateral-line scales and exhibit slight variation in numbers of fin rays and vertebrae or colour pattern. They are frequently identified only to genus in faunal surveys (Ekau 1990). Among the species of *Pogonophryne*, barbels range from short and tapered to long structures with prominent terminal expansions and elaborate patterns of cutaneous projections and folds (Eakin 1990). There has, however, been no study of intraspecific variation in barbel morphology. This is an important omission because artedidraconids are frequently captured by benthic trawling and contribute substantially to fish species diversity and abundance on the Antarctic shelf. For example, in the Weddell and Ross seas, they comprise 20–23% of the species diversity and 2–14% of the abundance (Hubold 1992, Eastman & Hubold 1999). They are also encountered as by-catch in the longline fishery for toothfish of the genus *Dissostichus* (Arana & Vega 1999). Accurate identification of specimens of *Pogonophryne* is therefore essential.

One of the most difficult identification problems within the genus has been that of separating the three very similar species of the "dorsally-unspotted" group (*P. scotti* Regan, *P. phyllopogon* Andriashev and *P. dolichobranchiata* Andriashev) which have been distinguished mainly by barbel morphology. A paucity of specimens representing an adequate size range for each of these species has previously precluded a quantitative analysis of barbel variation within the group which has recently been reduced to a single species, *P. scotti* (Balushkin & Eakin 1998, Eastman & Eakin 2000). We have at our disposal the largest collection of *Pogonophryne scotti* examined to date (92 specimens representing juveniles and adults of both sexes and possessing all three barbel types exhibited by the "dorsally-unspotted" group as well as a previously unknown type with brainlike convolutions). In this paper we will: 1) document intraspecific variation in mental barbel size, shape and ornamentation, 2) relate barbel variation

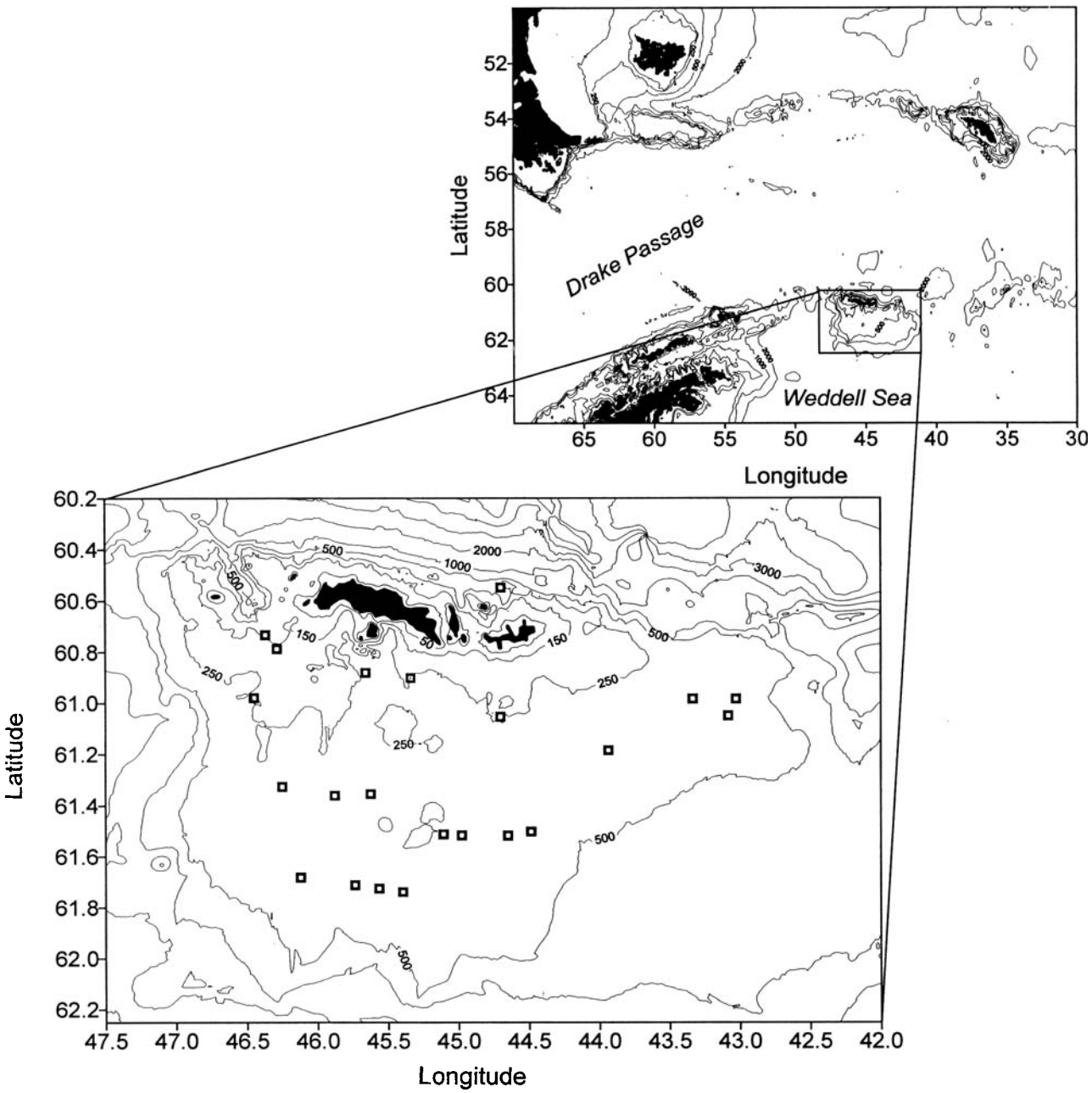


Fig. 1. Map of the vicinity of the South Orkney Islands showing bathymetry and locations of collecting sites.

to specimen size and sex, and 3) examine the histological aspects of barbel variation.

Materials and methods

Specimens of *Pogonophryne* were collected as part of a biomass survey of finfish stocks around the South Orkney Islands (Jones *et al.* 2000). The South Orkney Islands are a Southern Ocean island group located in the Scotia Arc, northeast of the Antarctic Peninsula at the confluence of the Scotia Sea and the outflow of the Weddell Sea (Fig. 1). Specimens were collected within the 500 m isobath aboard the Russian research vessel RV *Yuzhmorgeologiya*, 9–25 March 1999. The fishing gear used was a commercial size bottom trawl (Hard Bottom Snapper Trawl) with vented V-Doors, both manufactured by Net Systems, Inc. of Bainbridge Island, WA, USA. A "Netsweep 325" net sonar system (Ocean Systems, Inc.) was used to record the net mensuration as well as the trawl interaction with the bottom. The average height and width of the trawl mouth during fishing operations were 9.2 m and 20.3 m, respectively.

The sampling strategy was based on random depth stratified

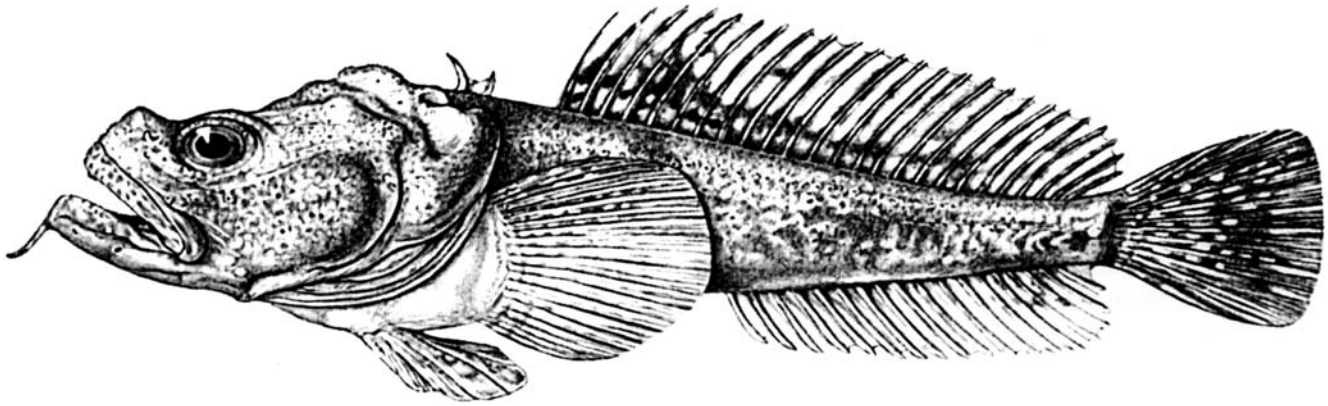


Fig. 2. Illustration of the holotype of *Pogonophryne scotti* showing barbel morphology previously considered typical of the species (from Regan 1914).

survey design. All hauls were conducted during daylight hours and averaged 30 min. Sixty-four hauls were made around the South Orkney Islands and *Pogonophryne* specimens were collected at 22 sites (Fig. 1). All except one specimen were found on the southern shelf of the island chain. A total of 100 specimens (92 *P. scotti* and 8 *P. marmorata*) was collected, 76 of these at five sites, all with bottom depths greater than 250 m. A single haul at the southernmost station yielded 32 specimens. Interestingly, most *Pogonophryne* were collected at stations with the lowest combined biomass of 41 other species of finfish. The specimens were deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC, USA under catalogue numbers USNM 364089–364107.

After specimens were retrieved from the trawl net, they were measured to the nearest cm TL (10–31cm; mean 20.4 cm), weighed to the nearest g (14–454 g; mean 160.9 g) and immediately tagged and transferred to 4% buffered formalin. Several months later they were preserved in 40% isopropyl alcohol and eventually transferred to ethyl alcohol. Of the 92 specimens of *P. scotti*, 55 are males (70–217 mm SL; mean 155.9 mm SL) and 37 are females (79–258 mm SL; mean 177.4 mm SL).

In all our specimens we measured standard length (SL) and mental barbel length (MBL) and derived the proportion MBL as % of SL. Specimens were sexed by inspection of the gonads under magnification. We treated sex, size (SL) intervals and barbel types as categorical variables. We assigned specimens to large, medium and small size intervals on the basis of ± 1 s d above or below the mean SL (mean 164.5 mm; large specimens > 210 mm SL; small specimens < 119 mm SL). We also assigned specimens to one of five types based on the appearance of the skin surface projections on the tip of the barbel. The names of the barbel types are based on the appearance of the barbel (e.g. with a brainlike terminal expansion or resembling the barbel of *P. scotti*, *P. phyllopogon*, *P. dolichobranchiata* or indeterminate).

To evaluate the influence of sex on the morphometric measurements, we performed independent *t*-tests with sex as the grouping variable. We used contingency tables to summarize and evaluate morphometric and categorical data. The Pearson chi-square was used as a non-parametric test of association among categorical variables and categorical and morphometric variables. In all cases the null hypothesis was that there is no association. In each table more than one-fifth of the fitted cells are sparsely populated, hence tests of significance are suspect. We nevertheless find these tables useful for summarizing our data. We employed the software program SYSTAT (5.2.1) for all statistical analyses.

For histology, we sampled one barbel from each of the *scotti*, *phyllopogon* and brainlike types. So few specimens possessed barbels of the *dolichobranchiata* type that these were saved as intact museum specimens. Barbels were removed and postfixed in Bouin's solution, then subjected to a standard histological protocol including embedding in paraffin and longitudinal sectioning at 7 μm. Sections were stained with hematoxylin and phloxine, Gomori's one step trichrome, Weigert's elastic stain or Bodian's Protargol for 24 h at 50°C.

History

As background information for our study, a summary of the taxonomic history of the three species now synonymized as *P. scotti* is desirable. Regan (1914) described a new genus and species of notothenioid fish, *Pogonophryne scotti* (Fig. 2) from an adult female (231 mm SL) collected in the Ross Sea, Antarctica. The holotype possesses a short (5.7% SL; DeWitt personal observation), tapered mental barbel covered with dermal papillae. According to Andriashev (1967), the barbel of this specimen has "blackish pigment spots forming 4 or 5 indistinct rings" around it.

Waite (1916) referred to a second specimen (184 mm SL; DeWitt personal observation) from the Davis Sea and Norman (1938) two others (female, 192 mm SL, mental barbel 5.3% SL; 187 mm SL, mental barbel 6.2% SL; DeWitt personal observation) from the Ross Sea.

Andriashev (1967), in his important review of *Pogonophryne*,

mentioned, in addition to the above four specimens, one from the Ross Sea (Reseck 1961). He also provided a detailed description of an adult male *P. scotti* (197 mm SL) collected off Enderby Land, East Antarctica, which resembles the holotype in most of the characteristic features. He described the mental barbel as "without terminal expansion, short (5.6% SL), somewhat compressed laterally, almost entirely covered with very small dermal papillae and warts."

Reports of five additional adult specimens from the Ross Sea and the South Shetland and South Orkney islands (196–256 mm SL) followed (Eakin 1977, Iwami & Abe 1982, Eakin & Kock 1984). In the most recent account of *P. scotti*, Eakin (1990) referred to the mental barbel as "slender 5.5–8.0 in HL, covered with papillae, and tapered to a point or rounded distally" and stated that "more examples (especially small specimens) of this relatively little-known species are needed to determine variation."

Andriashev (1967), in an addendum to this paper after it had gone to press, described two new species (*P. dolichobranchiata* and *P. phyllopogon*), based on three specimens collected off the South Orkney Islands, which he believed were closely related to *P. scotti* and distinguished from the latter by barbel morphology and certain anatomical and proportional differences. The holotype of *P. dolichobranchiata*, (male, 158 mm SL) possesses a relatively short (7.6% SL), stout barbel with a smooth stalk (no papillae) and a pronounced, cylindrical terminal expansion (40% of barbel length as measured from Andriashev 1967, fig. 7,1) composed of rounded and somewhat flattened, densely packed dermal processes. Long gill filaments (for which the species was named), a double row of teeth in the upper jaw, a projecting lower jaw (pointed rather than rounded), reduced posttemporal ridges and lack of dermal processes on the upper surface of the head were all Andriashev could otherwise find to distinguish this species from *P. scotti*. *Pogonophryne phyllopogon*, based on two juvenile specimens (holotype, male, 93 mm SL; paratype, female, 73 mm SL), is characterized by having a very slender barbel (10.8–13.0% SL) with a flattened, leaflike terminal expansion (33% of barbel length as measured from Andriashev 1967, fig. 7,2), a narrow head and a greatly projecting lower jaw containing a single row of teeth.

Eakin (1977) reported as *P. dolichobranchiata* two males (87.5–114 mm SL) from the Ross Sea (the larger one with an amputated barbel), one male (137 mm SL) from the Antarctic Peninsula, four females (202–238 mm SL) from the South Orkney Islands and one female (80.0 mm SL; USNM 147672) from Marguerite Bay, Antarctic Peninsula, the mental barbels of which range from 5.2 to 11.4% SL. He found no specimen with the leaflike barbel of *P. phyllopogon*. Eakin & Kock (1984) examined 19 specimens (11 juveniles, 48.5–79.0 mm SL; 8 adults, 117–216 mm SL), representing both sexes, from the Antarctic Peninsula, the South Shetland and South Orkney islands and the Weddell Sea; these have slender barbels similar in proportions and general appearance to those of *P. phyllopogon* (but with processes covering the surfaces of the terminal expansions).

Eakin (1981) mentioned without details [three] specimens (178–195 mm SL) of *P. dolichobranchiata* from the South Orkney Islands. Mental barbels of these specimens range from 6.2 to 8.4% SL; two of the three barbels have conspicuous terminal expansions (30.8–40.0% of barbel length), while that of the third is reduced.

Eakin & Kock (1984) suggested that Andriashev's type specimens of *P. phyllopogon* possess barbels "atypical" of the species in having smoothly flattened terminal expansions without papillae and demonstrated that specimens shorter than 80 mm SL have proportionally longer barbels (13.0–24.1% SL; mean 17.9% SL) than do specimens longer than 85 mm SL (6.0–11.9% SL; mean 9.5% SL). Seventeen of the 19 specimens examined by Eakin & Kock (1984) have intact barbels with terminal expansions ranging from 17.7 to 40.0% of barbel length (mean 25.4%). Eakin & Kock (1984) described and illustrated a male (184 mm SL) from the South Orkney Islands with a barbel (7.3% SL; terminal expansion 39.3% of barbel length) similar to that of the holotype of *P. dolichobranchiata* but lacking its long gill filaments. They noted that the male *P. dolichobranchiata* (137 mm SL) from the Antarctic Peninsula does not have a double row of teeth in the upper jaw, while a specimen of *P. scotti* (206 mm SL) does; furthermore, not all specimens of *P. phyllopogon* possess a single row of teeth in the lower jaw.

Andriashev (1967) mentioned the basic similarity in colour pattern (little or no spotting on the dorsal surface of the head and a conspicuous dark marking anteriorly at the base of the second dorsal fin) and certain meristics (relatively low numbers of vertebrae and second dorsal-fin rays) among all three species. Eakin (1977) divided the genus into two groups ("dorsally-spotted" and "dorsally-unspotted") based upon these consistent differences. The "dorsally-unspotted" group comprised *P. scotti*, *P. dolichobranchiata* and *P. phyllopogon*.

Eakin (1990, fig. 16) provided a ratio of measurements (interangular and interdentary distances) believed useful for separating *P. phyllopogon* and *P. dolichobranchiata*, the barbels sometimes being difficult to distinguish, given the revised interpretation of Andriashev's original "leaflike" morphology of the barbel to include processes on the terminal expansion (Eakin & Kock 1984). Head width seemed to be an important character, but since most specimens of *P. phyllopogon* known at that time were relatively small and most specimens of *P. dolichobranchiata* were larger, the possibility existed that head width, which increases proportionally with specimen size, was not a valid character in this case. Given the variation in barbel morphology (degree of flattening and development of processes on the terminal expansion) and colour pattern (unpigmented or with dark ringlike markings as in a specimen of *P. phyllopogon* illustrated in Eakin 1990, fig. 32) and no other consistent meristic, morphometric or colour differences, it appeared that the two species might be synonymous. *Pogonophryne scotti*, the

barbel of which exhibits some degree of variation (not always tapered distally but sometimes expanded slightly and with or without dark rings) and which was known only from large specimens, might prove to be conspecific as well.

Balushkin & Eakin (1998) therefore concluded that the three species comprising the "dorsally-unspotted" group are virtually indistinguishable and synonymized *P. dolichobranchiata* and *P. phyllopogon* with *P. scotti* based on examination of more than 50 specimens, including types, which exhibit individual variation in all the characters used to separate these three species.

Results and discussion

The 92 specimens in our sample measured 70.0–258.0 mm SL (mean 164.5 mm, s d 45.5). There are more large females (11) than males (1); these large females range from 213 to 258 mm SL (mean 230.0 mm SL) and weigh 304–454 g (mean 373.0 g), while the 10 largest males range from 194 to 217 mm SL (mean 201.1 mm SL) and weigh 236–303 g (mean 264.7 g). Mental barbel length (MBL) averages 13.2 mm (s d 2.1) and MBL as % of SL averages 8.5% (s d 2.2). With a sex ratio of 55 males/37 females, the sample is not significantly different than unity (chi-square test, chi-square = 3.12, df = 1, P = 0.076).

When t-tests are used to compare the influence of sex on SL and MBL, we find that females in this collection are significantly larger (t = 2.2; df = 67; P = 0.03) and have longer barbels (t = 2.4; df = 53; P = 0.02) than males. When the specimens are grouped by SL into three size intervals (Table I), a Pearson chi-square test for association also indicates that females are significantly larger than males. Relative barbel length is not significantly different between the sexes (t = 1.1; df = 86; P = 0.28).

Of the 30 possible combinations of the three variables (sex, size and barbel type), 19 are represented in the present material and 11 are not. Combinations not represented include "small and large male and female *dolichobranchiata*", "small male and female *scotti*", "small male and female brainlike", "large male *scotti*", "large male indeterminate" and "large male brainlike". We believe that the brainlike barbel, previously unknown among species in the "dorsally-unspotted" group of *Pogonophryne* and described here for the first time, represents a fuller development of the *dolichobranchiata* barbel; this would account for the apparent scarcity of the latter (represented by only four medium specimens of both sexes, 4.3% of the total collection). Full development of the brainlike barbel appears only after a fish attains a standard length of about 119 mm, accounting for the lack of this barbel type in the small specimens. The brainlike barbel is the most common type, occurring in 35 specimens (seven large females, nine medium females and 19 medium males; 38.1% of the total). The *phyllopogon* barbel is the second most common type and the most widespread, occurring in 26 specimens of both sexes and all sizes (28.3% of the total). The *scotti* barbel occurs in one large female and three medium specimens of both sexes and is one of the two least common types (4.3% of the total). Twenty-three barbels (25%) do not match any of the above three types (exhibiting various degrees of development of papillae and convolutions and mixtures thereof) and are referred to as indeterminate. This variable category occurs, as does the *phyllopogon* type, in both sexes and all sizes and provides significant evidence for considering the range of all barbel types as a continuum within a single species, *P. scotti*.

None of the barbel types is sexually dimorphic in barbel length or length of the terminal expansion, nor do the barbel types differ from each other in these measurements. The major morphological difference is in the degree of development of dermal processes (papillae, convolutions), especially distally, resulting in a more or less expanded tip.

Of 35 specimens with brainlike barbels, those of 19 medium males range from 6.6 to 10.6% SL (mean 7.9% SL), while those of 16 females range from 5.3 to 10.8% SL (nine medium specimens average 8.1% SL; seven large specimens average 7.1% SL). Terminal expansions of males range from 26.7 to 54.7% of barbel length (mean 39.6%), while those of females range from 26.7 to 56.7% of barbel length (mean 44.6%).

Of 26 specimens with *phyllopogon* barbels, those of 16 males range from 6.2 to 13.3% SL (five small specimens average 12.5% SL, 10 medium specimens average 7.4% SL and one large specimen measures 6.4% SL). The barbels of 10

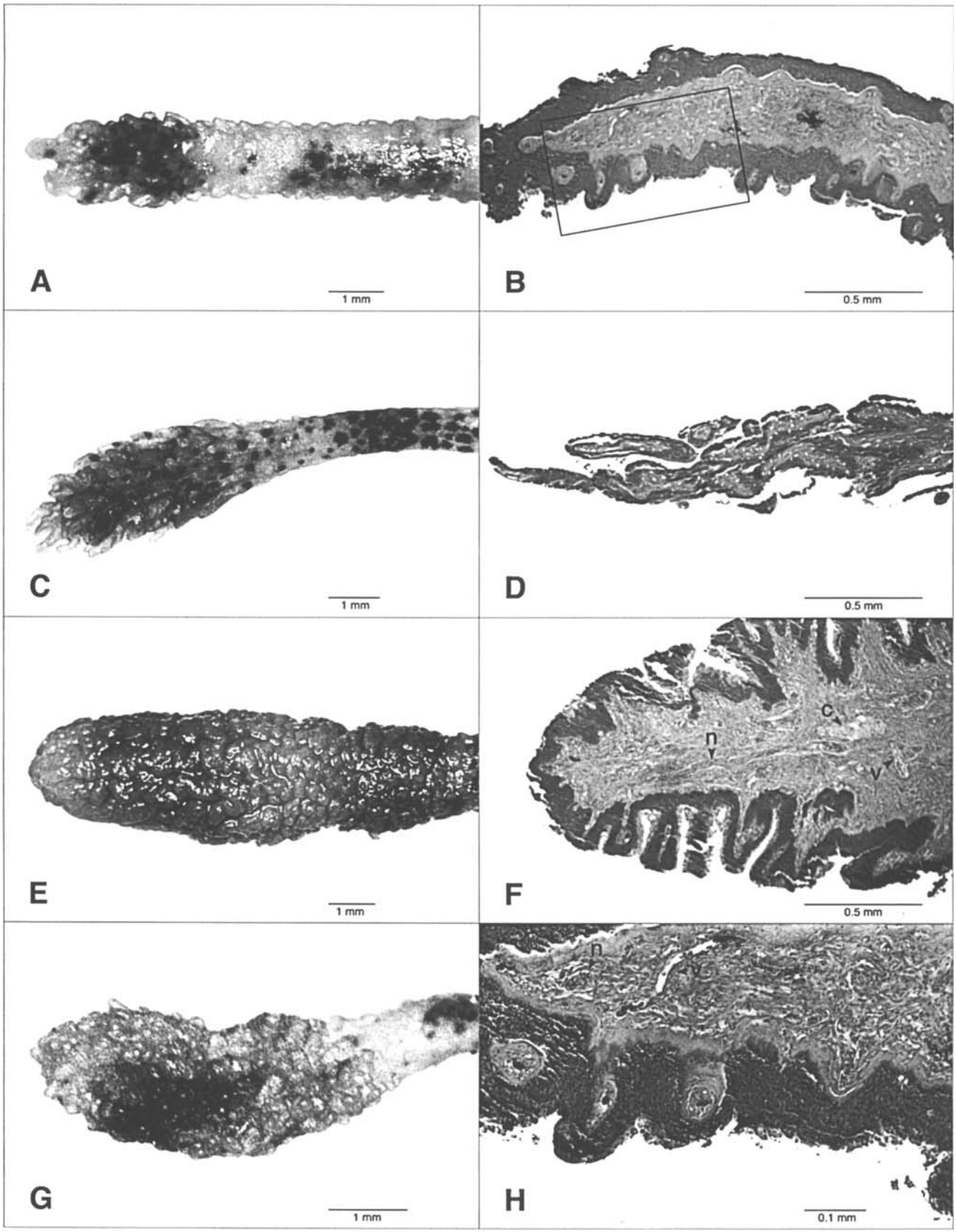
Table I. Contingency table of sex (rows) by size (columns) for *Pogonophryne scotti*. Pearson chi-square is test statistic for association.

Sex	Size interval: Large	Medium	Small	Totals (%)
Female	11	21	5	37 (40)
Male	1	43	11	55 (60)
Totals (%)	12 (13)	64 (70)	16 (17)	92 (100)

χ^2 = 15.20, df = 2, P = 0.0005

Table II. Contingency table of sex and size (rows) by barbel type (columns) for *Pogonophryne scotti*. Pearson chi-square is test statistic for association.

Sex	Barbel type: brain	*phyllopogon*	indeterminate	*dolicho -branchiata*	*scotti*	Totals (%)
female	16	10	8	1	2	37 (40)
male	19	16	15	3	2	55 (60)
Totals	35	26	23	4	4	92 (100)
(%)	(38.0)	(28.3)	(25.0)	(4.3)	(4.3)	
	χ^2 = 1.30, df = 4, P = 0.86, ns					
Size interval						
large	7	3	1	0	1	12 (13)
medium	28	16	13	4	3	64 (70)
small	0	7	9	0	0	16 (17)
Totals	35	26	23	4	4	92 (100)
(%)	(38.0)	(28.3)	(25.0)	(4.3)	(4.3)	
	χ^2 = 20.624, df = 8, P = 0.008					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females range from 5.7 to 12.3% SL (two small specimens average 11.9% SL, six medium specimens average 7.8% SL and two large specimens average 6.8% SL). Terminal expansions of males range from 27.3 to 47.6% of barbel length (small specimens average 33.6%, medium specimens average 36.6% and one large specimen measures 36.2%); those of females range from 23.1 to 48.1% of barbel length (small specimens average 32.2%, medium specimens average 34.5% and large specimens average 33.5%).

Of 23 specimens with indeterminate barbels, those of 15 males range from 5.1 to 14.3% SL (six small specimens average 13.1% SL and nine medium specimens average 7.6% SL). The barbels of eight females range from 6.7 to 13.0% SL (three small specimens average 11.8% SL, four medium specimens average 8.8% SL and one large specimen measures 6.7% SL). The terminal expansions of males range from 23.1 to 44.1% of barbel length (small specimens average 37.7%, medium specimens average 34.7); those of females range from 31.8 to 46.7% of barbel length (small specimens average 42.6%, medium specimens average 38.4% and one large specimen measures 36.4%).

The above figures for brainlike, *phyllopogon* and indeterminate barbel types agree with those given by Eakin & Kock (1984) for *P. phyllopogon* and demonstrate negative allometric growth of the mental barbel relative to body size.

Four specimens exhibit *scotti* barbels and two of these have slightly expanded (rather than tapered) tips. The barbels of two medium males range from 5.7 to 7.2% SL (mean 6.5% SL) and one has a slight terminal expansion measuring 23.6% of barbel length. The barbels of two females (large and medium) range from 5.5 to 6.6% SL (mean 6.1% SL); that of the large specimen has a slight terminal expansion measuring 30.0% of barbel length.

Four specimens exhibit *dolichobranchiata* barbels. Those of three medium males range from 8.9 to 9.5% SL (mean 9.2% SL), while that of one medium female measures 8.5% SL. The terminal expansions of males range from 36.0 to 45.8% of barbel length (mean 41.2%); that of the female measures 24.4% of barbel length.

Table II summarizes data for distribution of barbel type by sex and size interval. Sex and barbel type show no significant association, whereas size interval and barbel type do show significant association, with the brainlike barbel disproportionately common among large and medium specimens and the indeterminate and *phyllopogon* barbels more common among medium specimens. Significant tests of association between size interval and MBL and MBL as % SL (not shown) indicate that larger specimens have absolutely larger mental barbels ($P = 0.0001$) but smaller barbels relative to standard length ($P = 0.02$). Tests of association are significant in the case of barbel type and SL, and barbel type and MBL (not shown). The test of association is significant between barbel type and MBL as % SL ($P = 0.02$) and inspection of the table (not shown) reveals that the *scotti* barbel is consistently short (5.5–7.2% SL). Thirty-three of 35 specimens with brainlike barbels have barbels of short to intermediate length (5.3–8.8% SL). In the few specimens with the *dolichobranchiata* barbel, the barbel length is also intermediate (8.5–9.5% SL). The indeterminate and *phyllopogon* barbels are extremely variable in length, ranging from relatively short to relatively long (5.1–14.3% SL).

Barbel histology

The various barbel types of *Pogonophryne scotti* have a similar histological appearance. The stalk of the barbel consists of chondroid or pseudocartilage, a characteristic tissue of such appendages in fishes (Harder 1975, p. 19), surrounded by perichondrium. Peripheral to this is connective tissue containing large nerves and blood vessels. The pseudocartilaginous core of the stalk extends nearly to the middle of the terminal expansion in those types with a well developed expansion. The skin of the stalk and terminal expansion consists of epidermis, composed of stratified squamous epithelium, and an underlying dermis consisting of dense regularly arranged collagen fibres. The epidermis is 50 μm thick in the *phyllopogon* type, 75–100 μm in the brainlike type and 100–150 μm in the *scotti* type. Although variously shaped papillae and folds are characteristic of the skin of the terminal expansion in the barbels of *P. scotti* (Fig. 3a, c, e, g), the histology is the same (Fig. 3b, d, f). Cylindrical papillae (Fig. 3a, b), flattened papillae (Fig. 3c, d) and brainlike folds resembling gyri and sulci (Fig. 3e, f) all share a similar tissue arrangement. Papillae and folds are dermal projections covered by epidermis. The dermis is somewhat denser (Fig. 3h) than the adjacent connective tissue which accounts for most of the width of the terminal expansion. The terminal expansions are well vascularized (Fig. 3f, h) and the vessels extend into the dermis of the papillae or folds. Nerves are also abundant in the connective tissue of the terminal expansion (Fig. 3f, h) and in the dermal papillae, but can not be documented in the epidermis.

Fig. 3. (opposite) Gross anatomical (left column) and histological (right column) variation in the terminal expansions of barbels in sample of *Pogonophryne scotti* from the South Orkney Islands. **a.** *Scotti* type, spec. 5, SL = 195 mm, x 10.3. **b.** *Scotti* type, spec. 2, SL = 194 mm, x 44. **c.** *Phyllopogon* type, spec. 16, SL = 164 mm, x 9.5. **d.** *Phyllopogon* type, spec. 3, SL = 112 mm, x 44. **e.** Brainlike type, spec. 20, SL = 235 mm, x 8.6. **f.** Brainlike type, spec. 1, SL = 258 mm, x 44. **g.** *Dolichobranchiata* type, spec. 86, SL = 140 mm, x 14.6. **h.** Enlargement of outlined area of *scotti* barbel shown in **b**, x 110. In these histological sections stained with hematoxylin and phloxine, the darkly stained epidermis is distinguished from the underlying dermis and other connective tissue of the terminal expansion. Although papillae are differently shaped, they are histologically similar, consisting of a dermal projection covered by epidermis. Abbreviations: c = remnant of pseudocartilaginous core of barbel, n = nerve, v = blood vessel.

Summary

The mental barbel of *Pogonophryne scotti* exhibits considerable morphological variation with four distinct types and some intergrades; these are not correlated with geographical distribution. While all barbel types are fundamentally similar histologically, their tips may be expanded or not and covered by papillae, convoluted folds or a combination of both. These papillae and folds are dermal projections covered by epidermis. None of the barbel types is sexually dimorphic, but specimens of at least 119 mm SL generally have more highly developed terminal expansions covered with brainlike convolutions. Identification of *P. scotti* based on barbel structure alone demonstrates the danger of relying too heavily on a single highly variable taxonomic character.

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